

Limited Visual Dam Safety Inspections OA00018

Opaeula 01 Reservoir

Oahu, Hawaii

Prepared by:

U.S. ARMY CORPS OF ENGINEERS HONOLULU DISTRICT

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES

May 2006

Dam ID:	OA-018
Name:	Opaeula 01 Reservoir

Limited Visual Dam Safety Inspection Conducted on: 04 April 2006

I. Purpose:

Due to disaster occurrences of periodic heavy rains and flooding, which has caused extensive damage to property and loss of lives, the Governor has issued a State of Emergency Proclamation extending from February 20, 2006 to April 9, 2006. In light of the tragic failure of the Kaloko dam on Kauai and the continued forecast of heavy rains, emergency inspections of all regulated dams in all counties are being undertaken.

These inspections are for the purpose of determining if any of the regulated dams and reservoirs in the City and County of Honolulu, Maui County or Hawaii County, are suspect for immediate concern to the downstream area under the prolonged conditions of heavy rain showers.

II. Authority

Inspections were authorized under the Hawaii Dam Safety Act of 1987, Chapter 179D "Dams and Reservoirs" of Hawaii Revised Statues, and Title 13, Subtitle 7, Chapter 190, "Dams and Reservoirs" of the Hawaii Administrative Rules.

These inspections were conducted under joint agreements of the U.S. Army Corps of Engineers (ACE), the U.S. Department of Agriculture Natural Resources Conservation Service (NRCS), and the State of Hawaii. The Memorandum of Agreement with the U.S. Army Corps of Engineers is entered into pursuant to 10 U.S.C. § 3036(d)(2), and the Intergovernmental Cooperation Act (31 U.S.C. §6505), and established via support agreement number DL-06-01.

III. Scope

Visual inspection was performed on parts of the embankment and appurtenant works readily available and visible for inspection by the inspection team at the time of the inspection. Such parts and appurtenant works included the upstream slope, crest, downstream slope, abutments and toes, outlet works, and spillway.

On the date of this limited visual inspection, there may or may not have appeared to be any immediate threat to the safety of the dam, however no assurance can be made regarding the dam's condition after this date. Subsequent adverse weather and other factors may affect the dam's condition.

IV. Limitations of Findings and Recommendations

The inspection is based only on visible features/areas of the dam on the day of inspection. The inspection does not entail detailed stability, hydrologic, hydraulic, or seismic investigations. This inspection is not a formal phase I or phase II dam safety inspection and does not include a review or evaluation from each specialist of an inspection team, such as a geologists, civil, geotechnical, structural, or hydraulics engineer. The owner should verify the findings of this report and take corrective actions. The owner may submit to the State alternative corrective actions that are certified by a licensed professional engineer in the State of Hawaii experienced in the design and construction of dams. This inspection does not relieve the owner/operator from their responsibility to conduct routine inspections, maintenance, repairs, modifications, monitoring, documentation, and/or investigative studies.

Name: Opaeula 01 Reservoir

V. Inspection Team

Organization

U.S. Army Corps of Engineers

State of Hawaii, Dept. of Land and Natural Resources

National Resource Conservation Service

Name

Mr. Troy Cosgrove

Mr. Carty Chang

Mr. Sherman White

VI. Owner's Representatives Present

Mr. Kaeo Duarte, Kamehameha Schools Ms. Kapu Smith, Kamehameha Schools Mr. Jim Lodl, Kamehameha Schools

VII. Summary Report Team

<u>Organization</u> <u>Name</u>

U.S. Army Corps of Engineers Mr. Derek Chow Mr. Joseph Koester

State of Hawaii, Dept. of Land and Natural Resources

Ms. Denise Manuel

Mr. Edwin Matsuda

VIII. Dam Type

The dam is an earthen embankment.

IX. Dam Classification

The current hazard classification of this dam is: High

Based on available data, this classification is believed to still be applicable.

Hazard Potential Classification based on the following:

Category	Loss of Life	Economic Loss
Low	None Expected	Minimal (undeveloped to
		occasional structures
		or agriculture)
Significant	Few (No Urban development and	Appreciable (Notable
	no more than a small	agriculture, industry or
	number of inhabitable	structures)
	structures)	
High	More than a few	Extensive community, industry
		or agriculture.

Based on inventoried storage and height data, the size classification of the dam is: Small

Size Classification based on the following:

Category	Storage (Acre-Feet)	Height (feet)
Small	< 1000	< 40
Intermediate	> 1000 and < 50,000	> 40 and < 100
Large	> 50,000	> 100

Name: Opaeula 01 Reservoir

X. Summary of Inspection:

Condition Rating Criteria: The conditional terms in this report are used to generally describe the conditions below. Inspections, monitoring, and additional investigations are considered to be incidental to all condition ratings.

Satisfactory Expected to fulfill intended function.

Fair Expected to fulfill intended function, but maintenance is

recommended.

Poor May not fulfill intended function; maintenance or repairs are

necessary.

Unsatisfactory Is not expected to fulfill intended function; repair, replacement, or

modification is necessary.

Unknown Not visible, not accessible, not inspected, or unable to determine

the condition rating based on the observation taken.

A. General appearance:

The reservoir and dam features were easily recognizable.

Modifications / Improvements: There were no signs of any recent modifications.

Based on topography, limited offsite drainage is expected.

The reservoir appeared to have a small surface drainage area.

Based on staff personnel, this reservoir has no incident history.

- a. The Owner shall maintain documentations including Construction plans, specifications, improvements, modifications, Operations and Maintenance Manuals and routine inspection logs for this dam facility.
- An EAP is required for High Hazard Dams. Submit an updated EAP for this facility.
- c. Routine inspection logs were not inspected.
- d. Dam owners shall provide for routine inspection of the dam.
- e. Access to site appears to be satisfactory.
- f. Submit current Operations and Maintenance Manual or Procedures for this dam / reservoir facility.
- g. Submit Site or Facility Map of this Dam which identifies the location of major features including outlet works controls and conduits.
- h. Submit copies of additional studies conducted (Phase II inspection).
- i. Emergency Alarms / Monitors: There were no alarms or monitors observed on this reservoir.
- j. Power / Communication: There were no communication systems observed on this reservoir. There were no utility or power poles visible nearby.

B. Access / Security:

Access to the dam was accomplished via a private roadway. Access requires a 4 wheel drive vehicle.

Valves are locked. Access to the dam is via locked gates.

C. Inflow Works:

The inflow works were not observed. However, according to staff personnel, there are about 5 inlets feeding the reservoir. These are via a Culvert/pipe/ditch and/or flume

The intake or inlets have the ability to be shut off or diverted away from the reservoir during periods of heavy rains. This is done manually.

Findings and Corrective Actions:

- a. The intake works were not inspected.
- b. The intake works were not tested.

D. Reservoir

The reservoir level during the inspection was 55 ft per the staff gage.

A staff gage was observed near the left side of the reservoir.

According to staff personnel, the reservoir is normally operated at +/- 40 ft per gage. Typically the spillway is not flowing.

Findings and Corrective Actions:

a. The reservoir was not inspected.

E. Upstream Slope (Fair)

The upstream slope was roughly 1V to 2H (Vertical / Horizontal)

A dumped rock slope protection was observed. Little vegetation was observed growing between the rocks.

Erosion was observed on right side of dam near abutment.

Cracks were not observed.

Sinkholes were not observed.

The upstream slope was visible.

- a. The upstream slope appeared to be in fair to poor condition and requires corrective action.
- b. Rut and/or Gully erosion was observed on the slope, which requires maintenance and/or repair. Description: Fill and compact gully.
- c. Tree(s) were observed on the dam embankment. Trees have been identified as the probably cause of piping failures, and can possibly cause severe damage to the embankment if they are uprooted during a high winds. Corrective action is required to remove the tree hazards from the dam. Acceptable remedies include removal of the tree and its root structure down to a 2" diameter and

reconstructing the damaged embankment section. All repair work shall be accomplished as per the requirements of licensed geotechnical or structural engineer.

d. Maintain vegetation so embankment is visible.

F. Crest: (Fair)

The dam crest was approximately 15 feet wide.

There was a dirt access road on top of the crest that appeared to be well utilized. There was little vegetation on either edge of the crest, which consisted of some low ground cover and high grass.

An erosion gully was observed at the entrance to the crest on the left site of the dam. This could be problematic if not corrected.

Cracks were not observed.

Sinkholes were not observed.

Findings and Corrective Actions:

- a. The dam crest appeared to be in fair to poor condition and requires corrective action.
- b. Access along the crest was satisfactory.
- c. Rut and/or Gully erosion was observed on the crest, which requires maintenance and/or repair. Description: Fill and compact gully. Grade surrounding area to drain without erosion.

G. Downstream Slope: (Fair)

The downstream slope was in fair condition with some high grass and a few trees.

The slope was very steep, around a 1V to 1H slope.

There was access to the downstream slope via a walking path.

There was no slope protection observed on the downstream slope.

Erosion was observed on the downstream walking path and no erosion was observed on the downstream slope.

Sinkholes were not observed on the downstream slope, however the slope was not entirely visible.

Vegetation was observed on the downstream slope. The majority of the vegetation was high grass with a few woody trees less than 6" in diameter.

Seepage was not observed on the downstream toe, however the slope was not entirely visible.

- a. The downstream slope appeared to be in fair to poor condition and requires corrective action.
- Rut and/or Gully erosion was observed on the slope, which requires maintenance and/or repair. Description: Repair gully on access path by filling, compacting, and regrading. If not corrected could be problematic.
- c. The down stream slope was not visible due to high grass and bush vegetation. Clear high vegetation and maintain low to enable easy visual inspection.
- d. Tree(s) were observed on the downstream slope. Trees have been identified as the probably cause of piping failures, and can possibly cause severe damage to the embankment if they are uprooted during a high winds. Corrective action is

required to remove the tree hazards from the dam. Acceptable remedies include removal of the tree and its root structure down to a 2" diameter and reconstructing the damaged embankment section. All repair work shall be accomplished as per the requirements of licensed geotechnical or structural engineer. Routinely monitor the damaged area for signs of settlement and seepage.

e. The slope was very steep, around a 1 to 1 slope, further study is required to verify slope stability.

H. Abutments / Toe: (Fair)

The abutments and toe appeared to be in good condition with some vegetation and tress near the toe.

Erosion along the abutment or toe was not observed.

Cracks in either direction were not observed, however the abutments and toe were not entirely visible.

Findings and Corrective Actions:

- a. The abutments/toe appeared to be in fair to poor condition and requires corrective action.
- b. The abutment/toe area was not visible due to high grass and bush vegetation. Clear high vegetation and maintain low to enable easy visual inspection.
- c. Tree(s) were observed along the abutment/toe. Trees have been identified as the probably cause of piping failures, and can possibly cause severe damage to the embankment if they are uprooted during a high winds. Corrective action is required to remove the tree hazards from the dam. Acceptable remedies include removal of the tree and its root structure down to a 2" diameter and reconstructing the damaged embankment section. All repair work shall be accomplished as per the requirements of licensed geotechnical or structural engineer. Routinely monitor the damaged area for signs of settlement and seepage.

I. Outlet Works: (Fair)

Not inspected in detail, not tested.

Water was above the upstream gate works.

The outlet works appeared to be two 18" pipes made of ductile iron. Only one of the pipe was operational.

The outlet works was controlled via a valve on the downstream side of the dam.

Seepage was not observed flowing near the exit of the outlet works from the dam.

- a. The outlet works were not tested.
- b. The outlet works appeared to be in fair to poor condition and requires corrective action.
- c. Suggest repairing unused valve and pipe to have a back-up if main fails. Back-up may also be needed in emergency situation.

J. Spillway: (Fair)

This spillway consisted of a tunnel in rock with a concrete entrance near the left abutment. The outlet of the spillway was not observed.

The rough dimensions were 10 ft high by 7 ft wide by approximately 100 ft long. The spillway channel plunges into a pool, which feeds a drainage swale that runs along the base of the downstream toe and then heads downstream.

The spillway approach was mostly clear with the exception of a area of trees and vegetation to the left of the entrance. This vegetation and trees should be cleared back from the entrance to prevent debris from entering the spillway tunnel. There was erosion observed near the spillway were it plunges into a pool. It is approximately a 50 ft plunge into the pool.

Further investigations should be conducted to conclude the capacity of the spillway.

Findings and Corrective Actions:

- a. The Spillway appeared to be in fair to poor condition and requires corrective action.
- b. A headcut was observed downstream of the spillway. Corrective / mitigative action is required to prevent this problem from moving upstream.
- c. Trees are unacceptable in the spillway channel and approach. Take corrective action to address the woody vegetation problem and repair the damaged area.
- d. Unclear if spillway is adequately sized. Spillway should pass the probable maximum flood. Verify spillway capacity and take corrective action as required.
- e. Monitor spillway plunge pool to ensure erosion does not damage spillway exit.

K. Down Stream Channel: (Unknown)

The down stream channel was not investigated.

If the dam were to fail, the resulting flood wave would probably enter a tributary to the Anahulu River.

There is a well-defined downstream channel.

Findings and Corrective Actions:

a. The downstream channel was not inspected.

XI. Additional Comments:

Original field inspection notes were scanned and are attached to this summary report. Included are several photos from the site visit to detail important features of the project, captioned to be self-explanatory. A Phase II was performed in 1998. Access to the spillway exit needs to be improved to inspect. Currently the exit is difficult to inspect because of the plunge pool.

Per e-mail dated 5/2/2006, 5:16 a.m. from Troy Cosgrove, USACE Intake Works:

Please indicate if the intake was a culvert/pipe or a ditch/flume. Type if intake unknown was not inspected. In the field it was stated that there is a series of ditches and tunnels that feed the reservoir.

Please describe the intake works to include, size, control and from. Size and control unknown not inspected. From stream diversion, as stated in field.

If it is a ditch/flume also indicate the dimension and shape. Dimension and shape unknown, not inspected.

Upstream slope:

Please indicate if sinkholes were observed. None observed.

Comments:

Please indicate if the dam presented a safety hazard at the time of inspection. The dam did not present a safety hazard at the time of inspection.

Also please comment to the owner about the erosion at the entrance to crest. Should it be corrected immediately (within 6 months)? It is recommended that the erosion at the crest be repaired within 6 months.

Would it be in their best interest to have a structural or geotechnical engineer assist them with the corrective action? Yes

Would the same apply for the spillway? The same would apply to the spillway.

Please provide comments about the vegetation blocking spillway entrance. There is a stand of tress near the spillway entrance that could be problematic during high flows. The trees do not block the entrance.

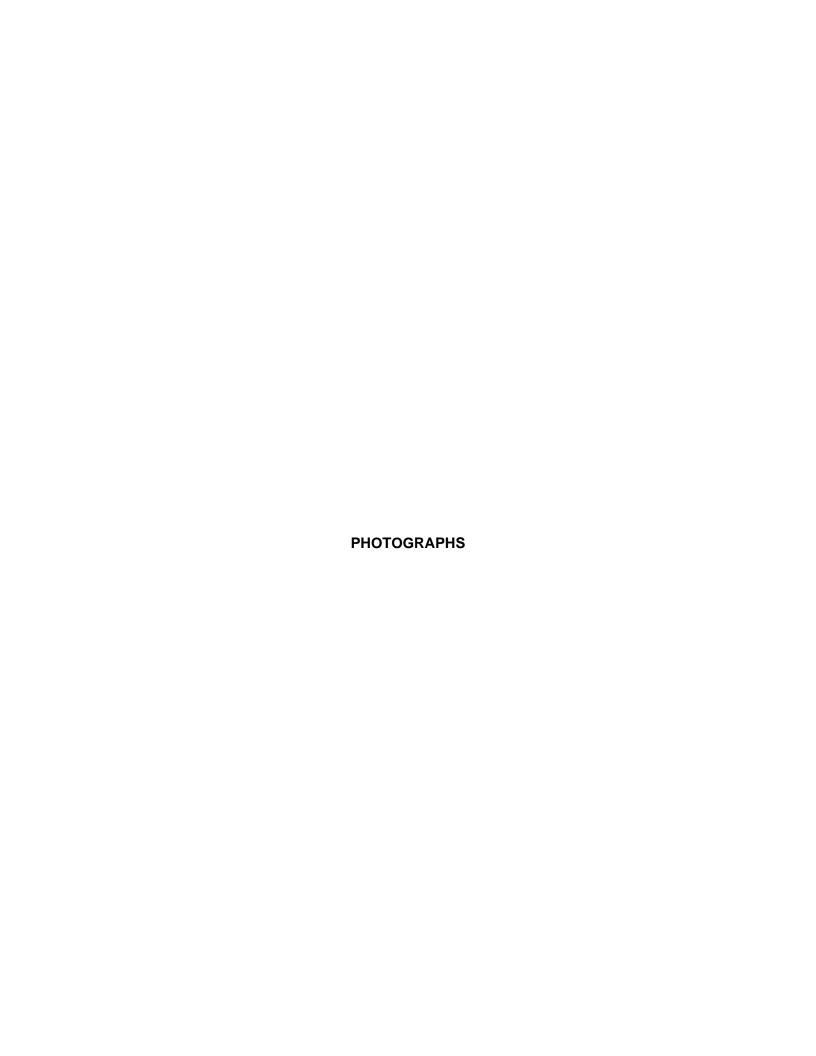




Photo 1 Spillway tunnel.



Photo 2 Spillway tunnel entrance.



Photo 3 Staff gage.



Photo 4 Upstream slope.



Photo 5 Downstream access road erosion.



Photo 6 Downstream slope.



Photo 7 Spillway plunge pool.



Photo 8 Outlet pipes.



Photo 9 Outlet channel.



Photo 10 Access pit at top of dam.



Photo 11 Spillway entrance, trees need to cleared.



Photo 12 Dam crest, erosion gully on access road.



Photo 13 Reservoir overview.



Dam ID: OA-0018
OPAEULA 01 RESERVOIR

Vulnerability Index:

Extreme High Moderate Low 1 2 3 4

STATE OF HAWAII - DLNR
DAM SAFETY INSPECTION SHEET

Inspection No: ______

US Army Corps of Engineers	Inspection Type:V	isual Dam Safety In	spection						
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am ID: OA-0018					Inspection No:
PAEULA 01 RESERVOIR					Date: 4/4/06
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2. Questions for Owner's Rep.:		No Unk	nown	Comments	
Construction Plans Available					
Site / Facility Map					
Operation & Maintenance Manua		0			3.4
Emergency Action Plan		a		Confact Plan inpla	ue @ KK schools
Modifications / Improvements		, 12			
Conduct Routine Inspections	Ø				
Conduct Routine Maintenance	Ø				
Vehicle access to site	Q'			☐ Not accessible ☐ With Stand	ard car Requires 4-Wheel Drive
Access during heavy rains	Ø			☐ Not accessible ☐ With Stand	ard car Requires 4-Wheel Drive
Access when spillway is flowing				☐ Not accessible ☐ With Stand	ard car Requires 4-Wheel Drive
Other Studies Conducted	Ø			, ,	ilics ☐ Stability ☐ Hazard ☐ Seismic
Other Studies Conducted	الكل		_	Other:	
Incident History				☐ Breached ☐ Overtop ☐ Slide	
Reservoir's Current Use	e			☐ Sediment ☐ Irrigation ☐ Recrea	ation 🔲 Flood Control 🔲 Drinking Water
				☐ Power Generation ☐ Other:	
□ d. An EAP is recommended □ e. Submit narrative and add dam site, unless covered g. Routine inspection logs of g. Dam owners shall provid □ h. The dam did not appear i. Access to site appears to i. Access to site appears to or access provided. □ k. Access to dam is question and emergency plans not □ l. Provide a detailed narrative required to promptly adv	d for a ditional by a were to be so be so cess to cess	all dams al information al information and inspector and i	regard ation of dam pected. Inspectined on ory. In site severe his defident, rement of	dless of hazard class. Submit Edetailing the improvements, more permit. Ition of the dam. It a regular basis. Operational and emergency per weather conditions and/or spill ficiency or access provided.	olans need to reflect this deficiency lway overflows. Operational plans ages incurred. Dam owners are d flood or unusual or alarming
m. Submit current Operatio					
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		Classific	ation		
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Dam ID: <u>OA-0018</u>	ins	spection No:
OPAEULA 01 RESERVOIR	Da	ite: <u>4/4/06</u>
Physical Dam Features	Check All Applicable. Provide description of Items Observed and/or Take Phot	tos. Indicate photo # in description.)
3. Reservoir: Level during inspe	ection55ft per999 e(gage / ot	her)
Normal Operating	Level/Range 40± ft per 909€ (gage / ot	her)
Typical Operation		
	Other:	☑ Not Visible ☑ None Observed
Sinkhole in Res.:	□ # Observed: in, Deep	La None Observed
	Description: Board with painted number	
Staff Gage:	Description: Both Dog of with printed number	<u></u>
Findings:		
a. The reservoir	r was not inspected.	
	r appeared to be in satisfactory condition, no corrective actions are	
□ c. The reservoir	r appeared to be in fair to poor condition and requires corrective act	tion.
☐ d. The reservoir	r appeared to be in unsatisfactory condition, urgent corrective action	n is required.
reservoir. □ g. A sinkhole wa identify the ca	was not observed at the reservoir. Provide some method of quanti- as observed in the upstream reservoir. Conduct additional investig ause, risk and appropriate action.	
	es 5/ / Pipe in. □ DIP □ Corrugated Metal □ PVC □ HDPE □ Concrete □ Oth I Gate □ Valve □ Flow can either be Shut off or Bypassed	
From:	1 Stream Diversion □ Pump □ Reservoir □ Other	
Control:	☐ Gate ☐ Valve ☐ Flow can either be Shut off or Bypassed	
From:] Stream Diversion □ Pump □ Reservoir □ Other	
b. The intake wc. The intake wd. The intake w	works were not inspected. works were not tested. works appeared to be in satisfactory condition, no corrective actions works appeared to be in fair to poor condition and requires corrective works appeared to be in unsatisfactory condition, urgent corrective a	e action.

☐ f. The intake works needs maintenance and/or repair. Description:

Corrective Actions:

Upstream Slope: Slope Protection:	(Typical Slope ± 1 v : 2 t) None Dumped Rock				
Erosion:	□ Defect in Protection: Description: □ Loose soil w/ little vegetation □ Rut (<6") □ Gully (>6" deep) □ Not Visible □ None Observed Description: €rosion right side Near abutront. Entire Shipe above water like				
Cracks:	☐ Parallel with crest ☐ Perpendicular to crest ☐ Slide visible ☐ Not Visible ☑ None Observed				
Sinkholes:	Description: and Depth				
Vegetation:	Description: Some lowcover and till grass, but pretty well maintained. Can See most of US face				
□ b. The upstream □ c. The upstream □ d. The upstream	slope was not inspected. slope appeared to be in satisfactory condition, no corrective actions are required at this time. slope appeared to be in fair to poor condition and requires corrective action. slope appeared to be in unsatisfactory condition and not expected to fulfill its intended function. tive action is required.				
Corrective Actions:	on needs maintenance or repair. Description:				
f. Rut and/or Gully erosion was observed on the slope, which requires maintenance and/or repair. Description: Fill and compact gully.					
☐ g. A crack was c	bserved on the slope, which requires further investigation to determine the underlining cause. ea and/or repair as required.				
☐ h. A sinkhole wa	s observed on the slope, which requires further investigation to determine the underlining cause.				
☐ i The unstream	slope was not visible due to high grass and bush vegetation. Clear high vegetation and				
Corrective ac of the tree an All repair worl	o enable easy visual inspection. Observed on the dam embankment. Trees have been identified as the probably cause of piping can possibly cause sever damage to the embankment if they are uprooted during a high winds. It is required to remove the tree hazards from the dam. Acceptable remedies include removal districture down to a 2" diameter and reconstructing the damaged embankment section. It is a shall be accomplished as per the requirements of licensed geotechnical or structural engineer. In the damaged area for signs of settlement and seepage.				
	Erosion: Cracks: Sinkholes: Vegetation: Findings: a. The upstream b. The upstream c. The upstream Urgent correct Corrective Actions: e. Slope protective Actions: g. A crack was on Monitor the arrow Monitor the arrow maintain low the failures, and corrective action of the tree and All repair work.				

Dam ID: OA-0018

OPAEULA 01 RESERVOIR

Inspection No:

Date: _

6.	Crest:	Approximate Crest Width: 32 15 ft
	Access:	□ None □ Walking Path □ Roadway, Surface / Width / Usage: □ 17 1
	Erosion:	□ Loose soil w/ little vegetation □ Rut (<6") □ Gully (>6" deep) □ Not Visible □ None Observed
		Description: Some erosion at entrance to crest. Could be problem tic
	Cracks:	☐ Parallel with crest ☐ Perpendicular to crest ☐ Slide visible ☐ Not Visible ☐ None Observed // C+ Corr
		Description:
	Sinkholes:	□ in. Wide x in. Long x in. Deep □ Not Visible ☑ None Observed
		Description:
	Vegetation:	□ None ☑ Low Ground Cover ☑ Bushes or Tall Grass □ Trees # □ <6" □ >6" & <20" □ >20" Description: Some Till grass but was visible.
	☐ d. The dam cress Urgent correct Corrective Actions: ☐ e. Access along	st appeared to be in fair to poor condition and requires corrective action. st appeared to be in unsatisfactory condition and not expected to fulfill its intended function. etive action is required. the crest was satisfactory.
	D a But and/or G	the crest was not possible. Description:ully erosion was observed on the crest, which requires maintenance and/or repair. Fill and compact gully and grade to drain without grosion.
	☐ h. A crack was Monitor the a	observed on the crest, which requires further investigation to determine the underlining cause. Irea and/or repair as required.
	Repair and m	as observed on the crest, which requires further investigation to determine the underlining cause. nonitor the area.
	☐ j. Portions of the maintain low	ne crest were not visible due to high grass and bush vegetation. Clear high vegetation and to enable easy visual inspection.
	failures, and Corrective ac of the tree ar All repair wo	observed along the dam crest. Trees have been identified as the probably cause of piping can possibly cause sever damage to the embankment if they are uprooted during a high winds. It is required to remove the tree hazards from the dam. Acceptable remedies include removal and its root structure down to a 2" diameter and reconstructing the damaged embankment section. It is shall be accomplished as per the requirements of licensed geotechnical or structural engineer. In onitor the damaged area for signs of settlement and seepage.

Dam ID: OA-0018

OPAEULA 01 RESERVOIR

Dam ID: <u>OA-0018</u>	Inspection No:
OPAEULA 01 RESERVOIR	Date: <u>4/4/06</u>
7. Downstream Slope: (1	「ypical Slope ± <u>/ / √</u> : <u>/ (√</u>)
·	□ walkway to outlet works □ None Observed
Slope Protection: ☑ None ☐ Dumped Rock ☐ Rip Rap ☐ Grouted Rip Rap	☐ Concrete
Erosion: ☐ Loose soil w/ little vegetation ☐ Rut (<6") ☐ Gully (>6" deep)	☑ Not Visible ☐ None Observed
Description: High grasses, rut/cully on	05 gress path
Cracks: ☐ Parallel with crest ☐ Perpendicular to crest ☐ Slide visible	☑ Not Visible ☐ None Observed
Description: High arasses	
Sinkholes:	Not Visible Sone Observed
Description: 1/2 h Gry 55es	
Vegetation: ☐ None ☐ Low Ground Cover ☐ Bushes or Tall Grass ☐ Trees	# few 0/6" 0 >6" & <20" 0 >20"
Description Street small tressand tall gra	
Seepage: Seep Spot Number 1	
☐ Green Vegetation ☐ Wet or Muddy Ground ☐ Ponding Water	☑ Not Visible ☐ None Observed
□ Flowing, Description: high gras 9	
Water Clarity: ☐ Clear ☐ Some particles ☐ Muddy ☐ Other	er:
Description:	
Seep Spot Number 2	
☐ Green Vegetation ☐ Wet or Muddy Ground ☐ Ponding Water	☑ Not Visible ☐ None Observed
□ Flowing, Description: <u> </u>	□ Other:
Description:	
 □ a. The downstream slope was not inspected. □ b. The downstream slope appeared to be in satisfactory condition, no correct. □ c. The downstream slope appeared to be in fair to poor condition and required. □ d. The downstream slope appeared to be in unsatisfactory condition and not be appeared. 	ires corrective action.
function. Urgent corrective action is required.	
Corrective Actions:	
 □ e. Slope protection needs maintenance or repair. Description: □ f. Rut and/or Gully erosion was observed on the slope, which requires ma 	intenance and/or repair.
Description: 6 ally was observed on the slope, which requires that	muy be problematic needs rep
 g. A crack was observed on the slope, which requires further investigation. Monitor the area and/or repair as required. 	to determine the underlining cause.
 h. A sinkhole was observed on the slope, which requires further investigate. Repair and monitor the area. 	
i. The down stream slope was not visible due to high grass and bush vego maintain low to enable easy visual inspection.	
g. Tree(s) were observed on the downstream slope. Trees have been ide failures, and can possibly cause sever damage to the embankment if the Corrective action is required to remove the tree hazards from the dam, of the tree and its root structure down to a 2" diameter and reconstructing All repair work shall be accomplished as per the requirements of license Routinely monitor the damaged area for signs of settlement and seepages.	ney are uprooted during a high winds. Acceptable remedies include removal high the damaged embankment section. High geotechnical or structural engineer. High geotechnical engineer.
 h. Seepage/Ponding water was observed. Monitor and conduct further in water and extent of any possible hazardous or developing condition. 	vestigation to locate the source of
 i. Seepage was observed flowing and particles were observed to be removaction to stop the loss of soil from the embankment. Conduct further in cause and take corrective action. Monitor the area. 	oved by the flow. Take immediate avestigation to determine the underlining
j. The slope was very steep, around a 1 to 1 slope, further study is require	ed to verify slope stability.

ım ID: OA-0018	Inspection No:
PAEULA 01 RESERVOIR	Date: 4/4/06
S. Abutments/Toe: Erosion:	□ Loose soil w/ little vegetation □ Rut (<6") □ Gully (>6" deep) □ Not Visible □ None Observed
Cracks	Description: Parallel with crest ☐ Perpendicular to crest ☐ Slide visible ☐ Not Visible ☐ None Observed
Cracks:	
Vegetation:	Description:
vegetation.	Description: Some vegetation and trees near tee
Seepage:	Seep Spot Number 1 Green Vegetation Wet or Muddy Ground Ponding Water Not Visible None Observed Plowing, Description: Water Clarity: Clear Description:
	Seep Spot Number 2 ☐ Green Vegetation ☐ Wet or Muddy Ground ☐ Ponding Water ☐ Not Visible ☐ None Observed ☐ Flowing, Description: Water Clarity: ☐ Clear ☐ Some particles ☐ Muddy ☐ Other:
	Description:
☑ c. The abutme ☐ d. The abutme Urgent corre Corrective Actions	ents/toe appeared to be in satisfactory condition, no corrective actions are required at this time. ents/toe appeared to be in fair to poor condition and requires corrective action. ents/toe appeared to be in unsatisfactory condition and not expected to fulfill its intended function. ective action is required.
☐ f. Rut and/or (ction needs maintenance or repair. Description:
☐ g. A crack was / underlining	s observed along the abutments/near the toe, which requires further investigation to determine the cause. Monitor the area and/or repair as required.
Maintain lov	ent/toe area was not visible due to high grass and bush vegetation. Clear high vegetation and w to enable easy visual inspection.
i. Tree(s) wer failures, and Corrective a of the tree a All repair we Routinely m	e observed along the abutment/toe. Trees have been identified as the probably cause of piping d can possibly cause sever damage to the embankment if they are uprooted during a high winds. action is required to remove the tree hazards from the dam. Acceptable remedies include removal and its root structure down to a 2" diameter and reconstructing the damaged embankment section. ork shall be accomplished as per the requirements of licensed geotechnical or structural engineer. nonitor the damaged area for signs of settlement and seepage.
□ j. Seepage/Po water and e	onding water was observed. Monitor and conduct further investigation to locate the source of extent of any possible hazardous or developing condition.
□ k. Seepage w action to sto	as observed flowing and particles were observed to be removed by the flow. Take immediate op the loss of soil from the embankment. Conduct further investigation to determine the underlining take corrective action. Monitor the area.
□ I	

Dam ID: <u>OA-0018</u>	Inspection No:
OPAEULA 01 RESERVOIR	Date: <u>4/4/0%</u>
9. Outlet Works:	
Culvert / Pipe	and will be to the first
Type / Size:	27/18" pipes, left side always used, inlets in lake not visible
Culvert:	□ Concrete □ Masonry □ unlined earth □ Other
Pipe: 1	■ DIP □ Corrugated Metal □ PVC □ HDPE □ Concrete □ Other
Control Type: 1	□ Gate □ Valve □ Other
• '	☐ Control on Upstream side ☑ Control on Downstream side
Seepage:	□ Green Vegetation □ Wet or Muddy Ground □ Ponding Water □ Not Visible □ None Observed
	□ Flowing, Description:
,	Water Clarity: ☐ Clear ☐ Some particles ☐ Muddy ☐ Other:
1	Description:
Findings:	
/	s were not inspected.
b. The outlet work	s were not tested.
□ c. The outlet work	s appeared to be in satisfactory condition, no corrective actions are required at this time.
☑ d. The outlet work	s appeared to be in fair to poor condition and requires corrective action.
e. The outlet work	s appeared to be in unsatisfactory condition and not expected to fulfill its intended function.

☐ f. Seepage/Ponding water was observed. Conduct further investigation to locate the source of water and extent

g. Seepage was observed flowing and particles were observed to be removed by the flow. Take immediate action to stop the loss of soil. Conduct further investigation to determine the underlining cause and take corrective action. Monitor the area. Failures caused by seepage/piping along the outlet conduit are very

☐ h. Were not visible due to high grass and bush vegetation. Clear high vegetation and maintain low to enable

i. Repair unused value and pipe, if mainfails could be problematic backup could be needed in emergency situation.

Urgent corrective action is required.

easy visual inspection.

of any possible hazardous or developing condition.

common and are considered to be a dangerous situation.

Corrective Actions:

							L			
	500									
U. S	pillway:									
	Туре:		☑ Culvert/Pip	e □ Chann	el Lock	1	1.1	_ +	let not obsered	
		·	on: Tun							
	Dimension:	~10, J	17			unknown				
	Slope Protection			☐ Dumped		Fitted Rip Rap	☐ Grouted	Rip Rap	☐ Concrete	
			in Protection:	AND THE PERSON NAMED IN COLUMN TO PERSON NAM		1 Oth				
	Approach:	/	High Veg			Other:	ED Othor:	Plunge	200	
	Erosion:	⊞ ∕Scour	☐ Gully	☐ Headcut	1	Not Observed	Et dans	mark co	194 Clasien inst	
		Descripti	on: Atthr	al Murge	3/110	1001. 2 30	11 0000	7114 <u>- 0</u>	432 Crosion in f ≤6" & <20" □ >20" +4	
	Vegetation:	☐ None	☐ Low Gro	und Cover [∃ Bushes or , /	Tall Grass Let In	ees # <u>>০/૫૯</u>	_ LM*<0 LM*	t blockore	
		Descripti	on: <u>Clear</u>	Tress &	DACK FR	on Spillway	entranc	<u>e 10 pre</u>	vent blockage	
Fil	<i>ndings:</i> 1 a. The Spillwa ₎	, annoarec	to he in sa	tiefactory c	ondition r	no corrective ac	tions are re	auired at th	nis time.	
_ 	b. The Spillway	, appeared	to be in sa	ir to poor c	ondition at	nd requires cor	ective action	n.		
<u> </u>	r D. The Spillway	y appeared	to be in ia	satisfactor	v condition	and not exped	ted to fulfill	its intended	d function. Urgent	
L	corrective a	ction is red	uired.	ioatioiaotoi	y 00/10/100				-	
	33,733									
Co	orrective Actions	:			:- Danasi	ntion:				
	d. Slope protect					puon				
	e. The spillway	/ approacn	was blocke	ed. Clear a	ipproacii.	nintanance and	or renair			
L	f. Severe scot		was observ	ea which re	equires inc	airiteriarice ariu	roi repair.			
	Description:	Description:								
L	g. A neadcut (י action is red	g. A headcut (vertical drop in channel due to erosion) was observed downstream of the spillway. Corrective action is required to prevent this problem from moving upstream.								
C	h. Trees are ur	h. Trees are unacceptable in the spillway channel and approach. Take corrective action to address the woody								
	/ vegetation r	oroblem an	d repair the	e damaged	area.					
C	ថ្នាំ i. Unclear if sp	pillway is a	dequately s	ized. Spill	way shoul	d pass the prob	able maxin	num flood.	Verity spillway	
	capacity and	d take corr	ective actio	n as requir	ed.	10 C P	Cosion.	does no	+ Trusco soil	
	1 j. //ont	er spill	way pu	vice poo	1 10 00	nsure e	10)/01/	<u> </u>	e vi	
11. I	Down Stream Ch	annel:		A 1	1 1	7				
	Name:	Tribu	tany to	Hngr	Iulu r	Iver				
	Downstream:				ed Drainage		Drainage-way	□ Other		
	Items along St				☐ House:	s 🗆 Town		☑ Not Inspe	ected	
	Description:									
	,									
F	indings:			t inanaataa	ı					
_	a. The downst	tream chai	inei was no	it inspected	i. . caticfocto	on condition no	corrective	actions are	required at this	
L	b. The downst time.	tream chai	mei appeai	ed to be in	Salisiacio	ny condition, ne	0011000140	actionic are	,040,100,000	
r	ume. □ c. The downs	tream chai	nel annear	ed to be in	fair to poo	or condition and	d requires c	orrective ac	ction.	
	☐ d. The downs	tream cha	nnel appear	ed to be in	unsatisfa	ctory condition	and not exp	ected to ful	Ifill its intended	
	function. U	Irgent corre	ective action	n is require	d.	•	•			
		_								
C	Corrective Actions	s:								
1	Пе									

Dam ID: OA-0018

OPAEULA 01 RESERVOIR

Inspection No: _____ Date: <u>U/U/06</u>

Dam ID: OA-0018				Inspection No:	
OPAEULA 01 RESERVOIR				Date: <u>4/4/06</u>	2
Additional Comments:					. f . h f Al
On the date of this limited visu dam. No assurance can be m and other factors may affect the	ade regarding the c	lam's condition at	no immediate fter this date.	Subsequent a	dverse weather
Phase I perform Need to improve to inspect becau	d in 1998.			s a sangalan, sa mahaha sa malihada ahasi hahali di sali mayari manja mahahasi di di di sanah musa k	the formal of the A. I. Administration and the second of t
Need to improve	access to	spillway e	exit to	inspect	afficult
to inspect becau	ve of plus	e pool.	ay j Samunda Andri gan Samunda jira dhada dha san Samu		· · · · · · · · · · · · · · · · · · ·
	a support on the proposal state of the problem of the state of the sta	The state of the s			
	and the state of t	gamma appropriate may regional consistent at the secret ARA titled section on the consistence of the			
and the second s	nan nghi shi khashanii ililangiya ji ya kaya hiya and kashanin Jayarda kanaband sanabindi. Ak	man didagen (APP) o omen met met met de	migra arbini a Albahan Marajim Nati (1910) (1911) (1911) (1911) (1911)	k alle was a subsect of the subsect	on come a min had a a summar life M or for the ord one market a summar a summer.
	indigna, ambara sasa dikkanda maraya ya kuningi maraya ka kuningi maraya ka kuningi maraya ka kuningi maraya k		TV-Q-L-VL VIIIIIIII SISSAMA	CONTROL NO. 1871-18-18-18-18-18-18-18-18-18-18-18-18-18	are entremented and the state of the state o
Med high of the company of the state of the company	add Neith River Bellin (1900) ac ann ann ann ann agus agus ann ann ann an airig (1940) agus 1900 (1900) agus a	vandadolas (P.A. (1977) et al. (1977) et al. (1974) et	et – A.S. (1944) (III) de 1944 (Air, 400) (III), 400 (IIII), 400 (III), 400 (III), 400 (III), 400 (III), 400 (III), 400 (tistillistististististis (s. 1.0000) ykkikuun valtaan en esta enemmänä käytiken on esitä lää läisistes 18.	The Assistance of the Assistan
$A = \frac{1}{2} \left(\frac{1}{$	opening dawn (1901) (1900) (1900) (1900) (1900) (1900) (1900) (1900) (1900) (1900) (1900) (1900) (1900) (1900)	ong ngganaga na mananana kanin (1222-1223) (1222-1224) (1222-1224) (1222-1224) (1222-1224) (1222-1224) (1222-1	words vor de Maddille egymtele oppositiet op Austria (oppositiet op Austria (oppositiet op Austria (oppositiet	taataniilikkooli jäärideli Laivillääsije Pittyi yhtyyveennaannen vuonnatti jondintii kittiintii Tittiintii Tit	entheta delitationistis designations employed accommunity of a grant designation of the second second second s
	nessa tiitaaside tiittiiside ja ja ja minnessa kun	agustusin saara selakkika 4780-a partiisin etiin vakeekkiikkiikaki Viiiilaan kupun kapagan suura vatu saari	nto-you hadan sharasagaragaa halii hadaladayayay qoran yanaan ahaan ahaan ahaan ahaan ahaan ahaan ahaan ahaan a	oracidadatterita erriptiologii (ilm till trivillillariere, erre errennamerrel dich t	tiskolet tittitalattir-lakajirtakkolutionek-nerv-konerverenek-tille-till titlike-ritterek
AND AND SECURE OF THE AND	Lighteneyes sektemmen er "he" het til till till til til til till till t	Had trigger to the control of the co	g tryn-gall-ta a trad romann ar mae'r treidig y tryn y treidig a gaellan a gaellan a gaellan a gaellan a gaell	y way yn gynhagaer y trouweren o o'i wer lâthe 100 de 170	t administrative and the confession of the confession of the confession and confession and confession and conf
	dings is to the discovered to the material and an extension of the state of the sta	rana gunun matakan midakki ki	д, эксперай, Б, д-обимоский может ден ден жеренет четовый обт-бай ческого ден поставля в ден п	oogustaayayan kaaranasida waxayah horeenaan oo oo oo bibiidhii iraasiisii waxah ka ka ahaa ka ahaa ka ahaa ka a	n Schwarzeum Andritzen Speitrust unterdemmitten geschicht gegenüber im Affrich z. Armeinunden des "Andr
	gen filos e tas alta antica per un sector moderno com mengen possibilitates discontinues describitar anticator con con	marketermen en e			malificati titti piine te equ ammake'ntimefrine, quantitatiti ket saitiin m

Limitations and Intent of this Dam Safety Inspection:

This Dam Safety Inspection was conducted to assess the general overall condition of the reservoir/dam, identify visible deficiencies, and recommend areas of for monitoring, additional investigative studies and corrective actions. The inspection is based only on visible features/areas of the dam on the day of inspection. This inspection is not a formal phase I or phase II dam safety inspection and does not include a review or evaluation from each specialist of an inspection team, such as a geologists, civil, geotechnical, structural, or hydraulics engineer. The owner should verify the findings of this report and take corrective actions. The owner may submit to the State alternative corrective actions that are certified by a licensed professional engineer in the State of Hawaii experienced in the design and construction of dams. This inspection does not relieve the owner/operator from their responsibility to conduct routine inspections, maintenance, repairs, modifications, monitoring, documentation, and/or investigative studies. The inspection was conducted under the authority of the Hawaii Revised Statures Chapter 179D, and Hawaii Administrative Rules, Title 13, Chapter 190, titled "Dams and Reservoirs". Questions regarding this inspection should be forwarded to the Hawaii State Dam Safety Program; PO Box 373; Honolulu, Hawaii 96809; Ph. (808) 587-0236.

Revised: Dec. 1, 2003